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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
PERT, EVAN T	

ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 05/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/659,435	BASCERI ET AL.	
	Examiner	Art Unit	
	Evan Pert	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 April 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *65 and 68-103* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *92-103* is/are allowed.

6)☒ Claim(s) *65,68,69,71,72,74,75 and 84-88* is/are rejected.

7)☒ Claim(s) *70,73,76-83 and 89-91* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *11 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Allowable Subject Matter

1. The indicated allowability of claims 67-72 (as pending at the time of the last Office Action) is withdrawn in view of the newly discovered reference to Wei et al. (US 6,046,084) and Lin et al. (US 6,165,830). Rejections based on the newly cited references follow.

Claim Objections

2. Claims 78 and 79 are objected to for being dependent on themselves. The "claim 78" in claim 78 should seemingly read –claim 77— and "79" in claim 79 should seemingly read –78--. Correction is required.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 65, 68, 69, 74, 75 and 84-88 rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. (US 6,780,704 B1) in view of Wei et al. (US 6,046,084):

Regarding claims 65, 68, 69, 74, 75 and 84-85, the Raaijmakers et al. reference discloses a method of forming a MIS capacitor (abstract) on a semiconductor substrate (12) comprising the acts of: forming a semiconductive layer (i.e. HSG) over a substrate (12), forming a dielectric layer comprising aluminum oxide (col. 15, Table 1) over said semiconductive layer by ALD (col. 15, lines 19-26)., and forming a metal nitride layer over said dielectric layer (col. 21 , line 42 to col. 23, line 25).

Regarding claims 65, 68, 69, 74, 75 and 84-88, particularly claims 65, 68 and 69, the Raaijmakers et al. reference is silent about "opening the grains which form said layer of HSG to activate said grains" as is explained by applicant:

> The etching solution removes any native oxide formed over the HSG layer 60 and further enlarges the openings of the HSG grains and activates the HSG grains of the HSG layer 60. This way, the etched HSG layer 62 with activated HSG grains allows the subsequently deposited dielectric material to achieve good conformal properties with the etched HSG layer 62 and better step coverage [p. 11, applicant's specification].

While '704 reference is silent about "opening" and "activating" HSG grains (which is what happens to HSG when etched with HF as described by applicant in the passage above), the Wei et al. reference discloses the advantage of "opening the grains" of HSG (i.e. creating increased space between the grains) and activating the grains (i.e. etching with HF that cleans native oxide and opens the grains) [Abstract + col. 1, line 51 to col. 2, line 32 + col. 5, lines 4-26].

It would have been obvious to one of ordinary skill in the art at the time of the claimed invention to adopt the invention of improving HSG taught by Wei et al. (US 6,046,084) to improve the HSG in Raaijmakers et al. (US 6,780,704 B1).

One of ordinary skill in the art would have been motivated to adopt the HF etch of the HSG disclosed by the Wei et al. reference (thus "opening" and also "activating" the grains of the semiconductive layer which form the HSG), wherein the motivation would be "to address the problem of narrow spaces in the HSG when attempting to form a uniform capacitor dielectric layer" [col. 5, lines 4-25 of Wei et al.].

Regarding claim 74, the metal nitride layer is a titanium nitride layer formed by ALD (col. 22, lines 11-17 of the '704 reference).

Regarding claim 75, the TiN is formed by "ALD," therefore necessarily "using a nitrogen source and a titanium source precursor" (col. 22 of the '704 reference).

Regarding claim 84, the aluminum oxide dielectric layer is formed by ALD using an ozone source and an aluminum source precursor (col. 15 of the '704 reference).

Regarding claim 85, said aluminum source precursor is TMA (col .15, line 22 of the '704 reference).

Regarding claim 86, the aluminum oxide dielectric layer is formed to a thickness of about 10 angstroms to about 500 angstroms (col. 14, lines 27-45 of the '704 reference).

Regarding claim 87, aluminum oxide dielectric layer is formed to a thickness of about 25 angstroms to about 100 angstroms (col. 14, lines 27-45 of the '704 reference).

Regarding claim 88, the aluminum oxide dielectric layer fudher comprises a material selected from the group consisting of tantalum oxide, zirconium oxide, hafnium oxide, hafnium-aluminum-oxygen alloys and lanthanum-aluminum-oxygen alloys (col. 21, lines 17-40 of the '704 reference).

5. Claims 71 and 72 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. in view of Wei et al., as applied to claim 69 above, and further in view of Lin et al. (US 6,165,830).

Both the Raajimakers et al. and Wei et al. references are silent about subjecting the HSG to a phosphine anneal (i.e. a PH_3 anneal), and instead suggest in situ doping with phosphine. However, the reference to Lin et al. shows that it was known in the art to subject the HSG to a phosphine anneal, in order "to solve the capacitance depletion problem" [col. 1, lines 37-42].

It would have been obvious to one of ordinary skill in the art at the time of the claimed invention to adopt a phosphine anneal as in claims 72 and 71, to dope the HSG in order "to solve the capacitance depletion problem" [col. 1, lines 37-42].

Allowable Subject Matter

6. Claims 92-103 are allowed.

7. Claims 70, 76-83 and 89-91 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 92-103, the prior art does not disclose an advantage of Applicant's particular combination of forming HSG, forming a dielectric composite stack comprising aluminum oxide on the HSG and forming tungsten nitride over the dielectric composite stack.

Regarding claim 70, the prior art does not disclose particularly subjecting the HSG to an RTN process combined with the forming of aluminum oxide and a metal nitride.

Regarding claims 73, 76-80 and 82-83 the prior art teaches away from CVD by directing one to the advantage of ALD.

Regarding claim 81, the prior ad does not discuss an advantage of particularly choosing tungsten nitride.

Regarding claims 89-91, the prior art does not disclose the particular combination of aluminum oxide and tantalum oxide as claimed.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The reference to Sharan et al. (US 6,027,970) discloses opening and activating HSG grains "thereby facilitating formation of a uniformly thick capacitor dielectric over the HSG" [abstract].

The reference to Gutsche et al. discloses forming a capacitor by depositing aluminum oxide on HSG.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Evan Pert whose telephone number is 571-272-1969. The examiner can normally be reached on M-F (7:30AM-3:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ETP
May 23, 2005

EVAN PERT
PRIMARY EXAMINER